Classificacao2

May 21, 2019

1 0. Introdução

Trabalho:
Aluno: Maicon Dall'Agnol
R.A.: 151161868
Disciplina: Tópico em Aprendizado de Máquina
Objetivos :

- Escolha dois datasets rotulados.
- Realize a análise estatística, visualização e pré-processamento dos dados.
- Realize os experimentos criando duas bases de teste distintas:
- – considerando todos os atributos do dataset;
- – selecionando alguns atributos e descartando outros.
- Aplique três métodos de classificação distintos nas duas bases acima referentes a cada dataset.
- Para cada dataset, em cada uma das bases, analise os resultados segundo medidas de qualidade de classificação, usando índices de validação externa (acurácia, recall, precisão, F-measure, índice Kappa) e cruva ROC.
- Proponha uma maneira adicional de comparar os resultados obtidos além das medidas acima.
- Compare e interprete os resultados dos dois experimentos em cada dataset.
- Faça tabela com as medidas de validação

1.1 0.1 Dependências

Para realização da tarefa foram utilizados as seguintes bibliotecas:

```
In [282]: import pandas as pd
          import numpy as np
          import pandas_profiling

          from sklearn.preprocessing import LabelEncoder
```

```python
from sklearn.preprocessing import StandardScaler

# KFold
from sklearn.model_selection import KFold
import random

# Classificadores
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC

#Metricas
from sklearn.metrics import accuracy_score
from sklearn.metrics import recall_score
from sklearn.metrics import precision_score
from sklearn.metrics import f1_score
from sklearn.metrics import cohen_kappa_score
from  sklearn.metrics  import  roc_auc_score
from sklearn.metrics import balanced_accuracy_score

#Visualização
from mpl_toolkits.mplot3d import Axes3D
from sklearn.decomposition import PCA
import seaborn as sns
import matplotlib.pyplot as plt

import warnings
warnings.filterwarnings('ignore')
%matplotlib inline
```

2 1. Dados

Dataset correspondente a fonemas e composto de atributos abstratos cujo atributo alvo é a classe de som nasais ou orais (classe 1 e 2, respectivamente).

2.1 1.1 Informações sobre os dados:

Atributos:

- V1
- V2
- V2
- V4

Classe:

- Class

2.2 Importando Dataset

In [3]:
```
data_phoneme_raw = pd.read_csv('dados/phoneme.csv')
```

In [4]:
```
data_phoneme_raw.head()
```

Out[4]:

	V1	V2	V3	V4	V5	Class
0	0.489927	-0.451528	-1.047990	-0.598693	-0.020418	1
1	-0.641265	0.109245	0.292130	-0.916804	0.240223	1
2	0.870593	-0.459862	0.578159	0.806634	0.835248	1
3	-0.628439	-0.316284	1.934295	-1.427099	-0.136583	1
4	-0.596399	0.015938	2.043206	-1.688448	-0.948127	1

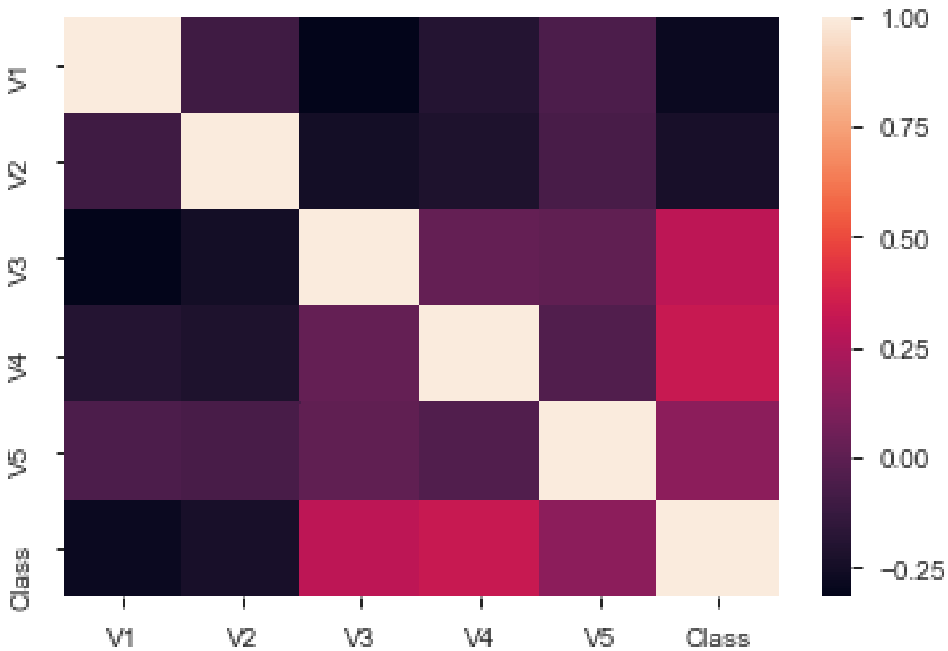
In [5]:
```
pandas_profiling.ProfileReport(data_phoneme_raw)
```

Out[5]: <pandas_profiling.ProfileReport at 0x7fe097237208>

2.3 Visualizações

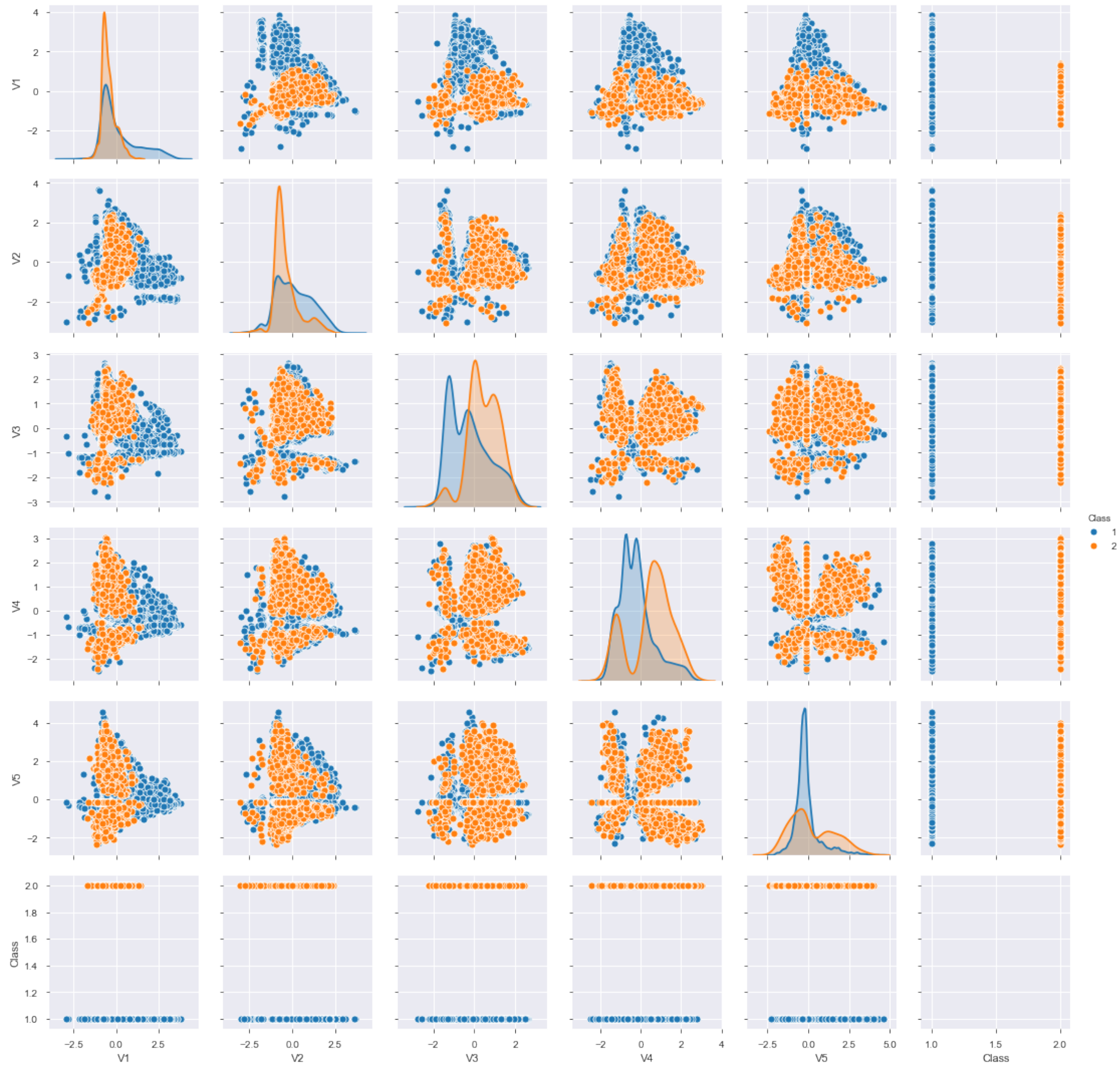
In [302]:
```
sns.heatmap(data_phoneme_raw.corr())
```

Out[302]: <matplotlib.axes._subplots.AxesSubplot at 0x7fe05351b630>



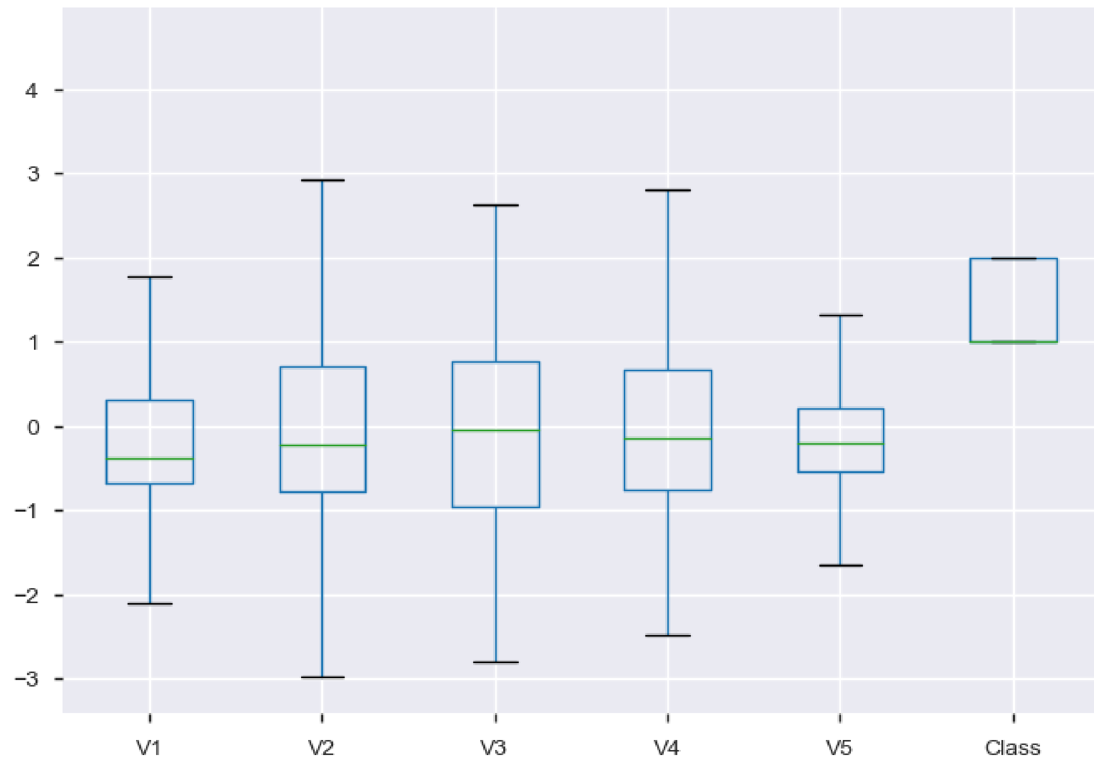
In [303]:
```
sns.pairplot(data_phoneme_raw, diag_kind="kde",hue='Class')
```

Out[303]: <seaborn.axisgrid.PairGrid at 0x7fe053505208>

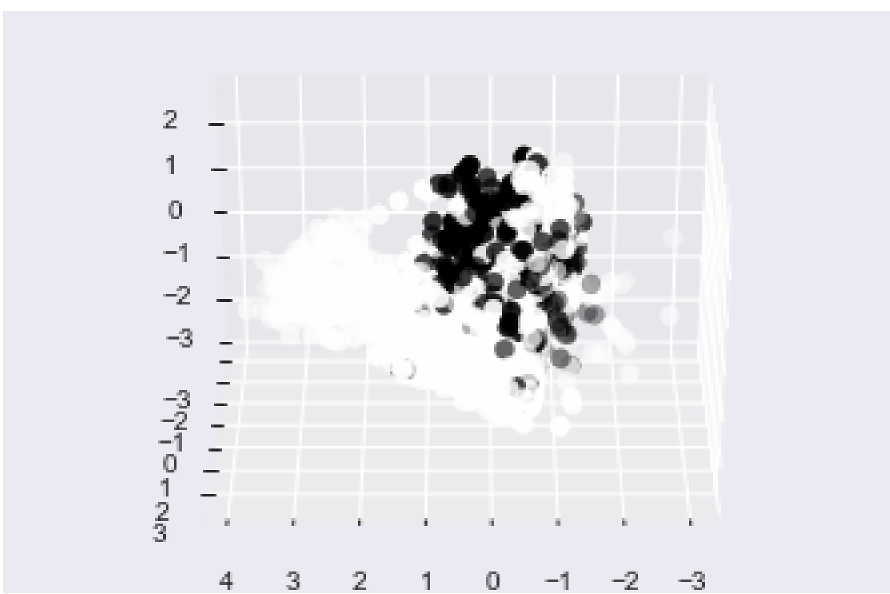



```
In [103]: data_phoneme_raw.plot.box()

Out[103]: <matplotlib.axes._subplots.AxesSubplot at 0x7fe06670cfd0>
```




```
In [304]: fig = plt.figure()
          ax = fig.add_subplot(111, projection='3d')
          ax.scatter(data_phoneme_raw.V1,data_phoneme_raw.V2, data_phoneme_raw.V3, c=data_phone
          ax.view_init(30, 90)
          plt.show()
```



2.4 PCA

In [374]:
```
data_pca = PCA(n_components=2).fit_transform(data_phoneme_raw.drop(columns=['Class']]
data_pca = pd.DataFrame(data_pca, columns = ['Var1','Var2'])
data_pca['Class'] = data_phoneme_raw['Class']
```

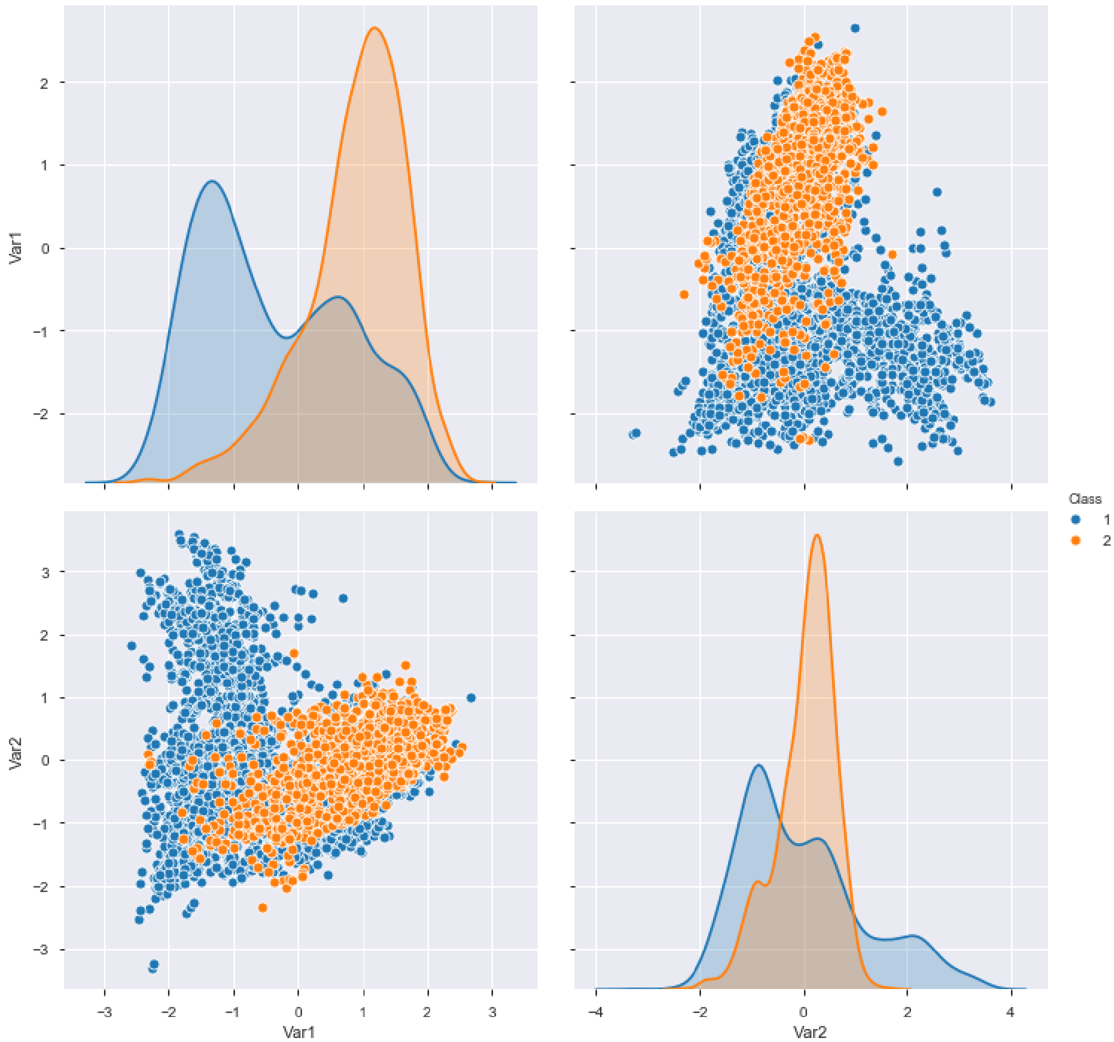
In [375]:
```
data_pca.head()
```

Out[375]:

	Var1	Var2	Class
0	-0.946325	0.652816	1
1	0.083178	-0.725027	1
2	0.530377	1.037576	1
3	0.990195	-0.796042	1
4	0.705725	-1.142581	1

In [376]:
```
sns.pairplot(data_pca, diag_kind="kde", vars = ['Var1', 'Var2'], hue='Class', size =
```

Out[376]:
```
<seaborn.axisgrid.PairGrid at 0x7fe047e47be0>
```



2.5 Rebalanceando as Classes com Random under-sampling

```
In [272]: count_class_1, count_class_2 = data_phoneme_raw.Class.value_counts()

          class_1_df = data_phoneme_raw[data_phoneme_raw['Class'] == 1]
          class_2_df = data_phoneme_raw[data_phoneme_raw['Class'] == 2]

In [273]: print('Class1:', count_class_1)
          print('Class2:', count_class_2)
```

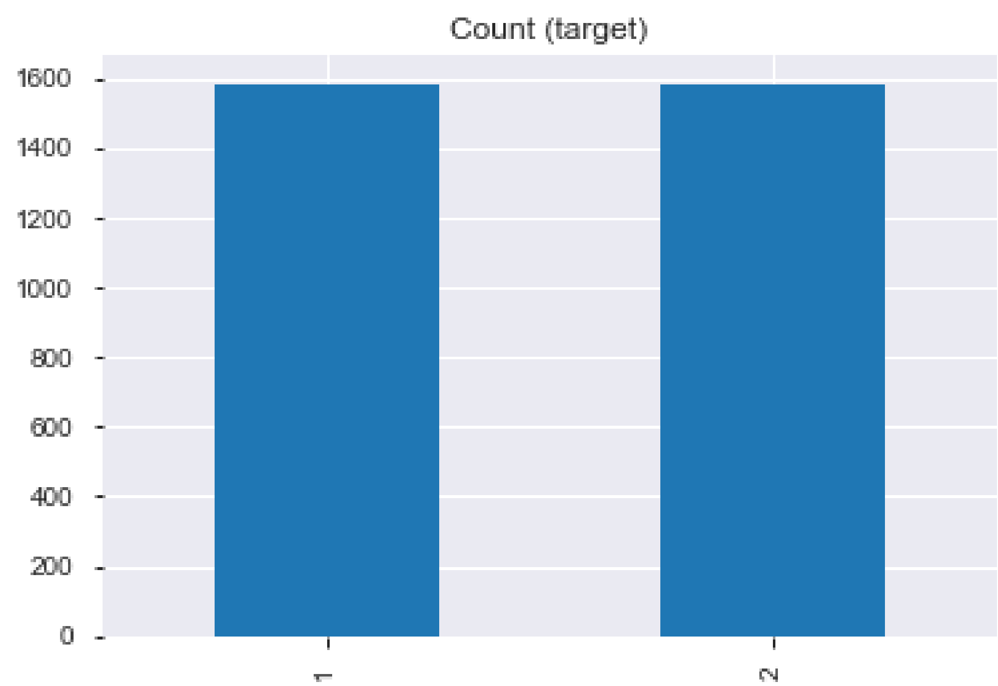
```
Class1: 3818
Class2: 1586
```

```
In [337]: under_class_1_df = class_1_df.sample(count_class_2, random_state=random.randint(2,10)
          balanced_df = pd.concat([under_class_1_df, class_2_df], axis=0)
```

```
print('Random under-sampling:')
print(balanced_df.Class.value_counts())

balanced_df.Class.value_counts().plot(kind='bar', title='Count (target)');
```

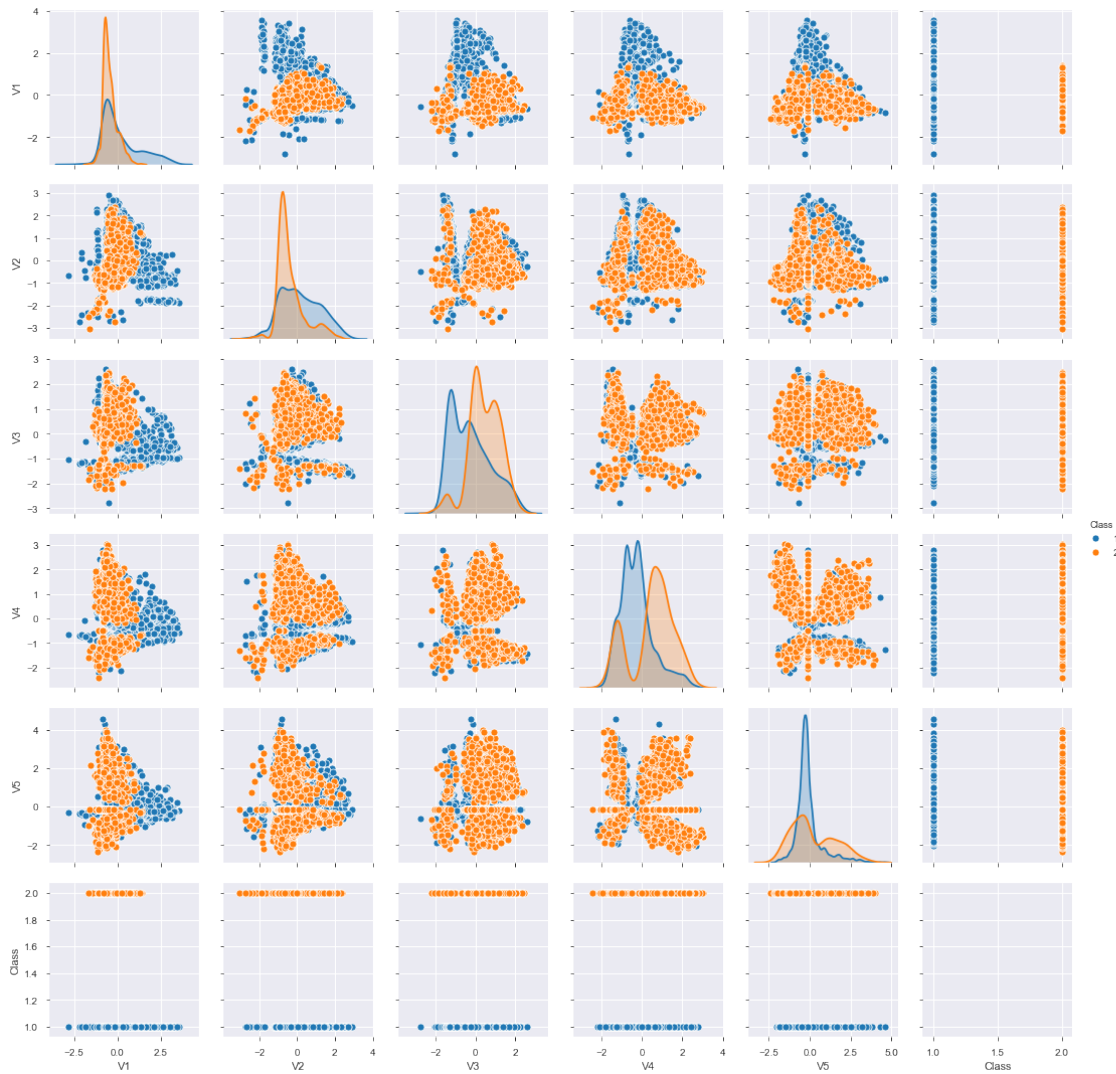
```
Random under-sampling:
1    1586
2    1586
Name: Class, dtype: int64
```



In [338]: `balanced_df.reset_index(inplace=True, drop=True)`

In [339]: `sns.pairplot(balanced_df, diag_kind="kde",hue='Class')`

Out[339]: `<seaborn.axisgrid.PairGrid at 0x7fe046103898>`



2.6 Classificando

2.7 Funções necessárias

```
In [430]: def calcula_metricas(metricas, y_test, y_predict):
              metricas['acc'] += (accuracy_score(y_test, y_predict))
              metricas['recall'] += (recall_score(y_test, y_predict))
              metricas['precision'] += (precision_score(y_test, y_predict))
              metricas['f1'] += f1_score(y_test, y_predict)
              metricas['roc'] += roc_auc_score(y_test, y_predict)
              metricas['kappa'] += cohen_kappa_score(y_test, y_predict)
              metricas['balanced_acc'] += balanced_accuracy_score(y_test, y_predict)
```

```
In [431]: def save_metricas(name, metricas):
              f = open(name, 'w')
```

```
        f.write('Acuária:' + str(metricas['acc']) + '\n')
        f.write('Recall:' + str(metricas['recall']) + '\n')
        f.write('Precisão:' + str(metricas['precision']) + '\n')
        f.write('F-Measure:' + str(metricas['f1']) + '\n')
        f.write('Curva Roc:' + str(metricas['roc']) + '\n')
        f.write('Indice Kappa:' + str(metricas['kappa']) + '\n')
        f.write('Acuária Balanceada:' + str(metricas['balanced_acc']) + '\n')
        f.close()
```

```
In [432]: def show_metricas(metricas):
              print('Acuária:', metricas['acc'])
              print('Recall:', metricas['recall'])
              print('Precisão:', metricas['precision'])
              print('F-Measure:', metricas['f1'])
              print('Curva Roc:', metricas['roc'])
              print('Indice Kappa:', metricas['kappa'])
              print('Acuária Balanceada:', metricas['balanced_acc'])
```

```
In [433]: def write_metricas(name_file, metricas, metodo):
              f = open(name_file, "a")
              f.write(metodo + ';')
              f.write(str(round(metricas['acc'],4)) + ';')
              f.write(str(round(metricas['recall'],4)) + ';')
              f.write(str(round(metricas['precision'],4)) + ';')
              f.write(str(round(metricas['f1'],4)) + ';')
              f.write(str(round(metricas['roc'],4)) + ';')
              f.write(str(round(metricas['kappa'],4)) + ';')
              f.write(str(round(metricas['balanced_acc'],4)) + '\n')
              f.close()
```

2.8 DataFrame Cru

```
In [456]: formato = 'Cru'
```

```
In [457]: data_np_x = data_phoneme_raw.drop_duplicates().drop(columns=['Class']).to_numpy()
          data_np_y = data_phoneme_raw.drop_duplicates()['Class'].to_numpy()
```

```
In [458]: folds_value = 10
```

```
In [459]: kf = KFold(n_splits=10, shuffle=True, random_state=random.randint(0, 10))
          data_kfold = kf.split(data_np_x)

          train = []
          test = []

          for train_index, test_index in data_kfold:
              train.append(train_index)
              test.append(test_index)
```

```
In [460]: name_file = 'metricas-' + formato + '.csv'

          f = open(name_file, "w")
          f.write(';Acurácia;Recall;Precisão;F1;Roc;Kappa;Acurácia Balanceada\n')
          f.close()
```

2.9 Aplicando KNN com K-fold

```
In [461]: metodo = 'KNN'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              neigh = KNeighborsClassifier(n_neighbors=1)
              neigh.fit(x_train, y_train)

              y_predict = neigh.predict(x_test)

              calcula_metricas(metricas, y_test, y_predict)

          for metrica, value in metricas.items():
              metricas[metrica] = value/10

          show_metricas(metricas)
          write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.9032357589500448
Recall: 0.9448511775439951
Precisão: 0.9204319683648994
F-Measure: 0.932438221179118
Curva Roc: 0.8734025919392348
Indice Kappa: 0.7612078035934119
Acuária Balanceada: 0.8734025919392346
```

2.10 Aplicando GaussianNB com K-fold

```
In [462]: metodo = 'Gauss'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              gauss = GaussianNB()
              gauss.fit(x_train, y_train)
```

```
        y_predict = gauss.predict(x_test)

        calcula_metricas(metricas, y_test, y_predict)

    for metrica, value in metricas.items():
        metricas[metrica] = value/10

    show_metricas(metricas)
    write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.7601587301587303
Recall: 0.7734891686424598
Precisão: 0.8730532145319696
F-Measure: 0.819959951920828
Curva Roc: 0.7502026641758153
Indice Kappa: 0.4635814301249811
Acuária Balanceada: 0.7502026641758153
```

2.11 Aplicando DecisionTreeClassifier com K-fold

```
In [463]: metodo = 'Tree'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              tree = DecisionTreeClassifier()
              tree.fit(x_train, y_train)

              y_predict = tree.predict(x_test)

              calcula_metricas(metricas, y_test, y_predict)

          for metrica, value in metricas.items():
              metricas[metrica] = value/10

          show_metricas(metricas)
          write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.8711784511784512
Recall: 0.9108228302643171
Precisão: 0.9072069404161821
F-Measure: 0.9089766766727794
Curva Roc: 0.8431826126971625
Indice Kappa: 0.6879177531835117
```

```
Acuária Balanceada: 0.8431826126971625
```

2.12 Aplicando SVM com K-fold

```
In [464]: metodo = 'SVM'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              svm = SVC()
              svm.fit(x_train, y_train)

              y_predict = svm.predict(x_test)

              calcula_metricas(metricas, y_test, y_predict)

          for metrica, value in metricas.items():
              metricas[metrica] = value/10

          show_metricas(metricas)
          write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.8487487116058544
Recall: 0.896382041737635
Precisão: 0.8903387040937798
F-Measure: 0.8932707817698
Curva Roc: 0.814812352136839
Indice Kappa: 0.6326600518433374
Acuária Balanceada: 0.8148123521368389
```

2.13 DataFrame PCA

```
In [465]: formato = 'PCA'

In [466]: data_np_x = data_pca.drop_duplicates().drop(columns=['Class']).to_numpy()
          data_np_y = data_pca.drop_duplicates()['Class'].to_numpy()

In [467]: folds_value = 10

In [468]: kf = KFold(n_splits=10, shuffle=True, random_state=random.randint(0, 10))
          data_kfold = kf.split(data_np_x)

          train = []
          test = []
```

```
for train_index, test_index in data_kfold:
    train.append(train_index)
    test.append(test_index)
```

In [469]:
```
name_file = 'metricas-' + formato + '.csv'

f = open(name_file, "w")
f.write(';Acurácia;Recall;Precisão;F1;Roc;Kappa;Acurácia Balanceada\n')
f.close()
```

2.14 Aplicando KNN com K-fold

In [470]:
```
metodo = 'KNN'
metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

for train_index, test_index in zip(train, test):
    x_train, x_test = data_np_x[train_index], data_np_x[test_index]
    y_train, y_test = data_np_y[train_index], data_np_y[test_index]

    neigh = KNeighborsClassifier(n_neighbors=1)
    neigh.fit(x_train, y_train)

    y_predict = neigh.predict(x_test)

    calcula_metricas(metricas, y_test, y_predict)

for metrica, value in metricas.items():
    metricas[metrica] = value/10

show_metricas(metricas)
write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.7801735037449323
Recall: 0.8450212951774543
Precisão: 0.8441342541984499
F-Measure: 0.8445076543254452
Curva Roc: 0.7338001421595584
Indice Kappa: 0.46787364047429725
Acuária Balanceada: 0.7338001421595584
```

2.15 Aplicando GaussianNB com K-fold

In [471]:
```
metodo = 'Gauss'
metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

for train_index, test_index in zip(train, test):
    x_train, x_test = data_np_x[train_index], data_np_x[test_index]
```

```
            y_train, y_test = data_np_y[train_index], data_np_y[test_index]

            gauss = GaussianNB()
            gauss.fit(x_train, y_train)

            y_predict = gauss.predict(x_test)

            calcula_metricas(metricas, y_test, y_predict)

        for metrica, value in metricas.items():
            metricas[metrica] = value/10

        show_metricas(metricas)
        write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.7792475778190063
Recall: 0.7870410829301134
Precisão: 0.8881304661780701
F-Measure: 0.8344378906510175
Curva Roc: 0.7731816613604637
Indice Kappa: 0.5057835947623386
Acuária Balanceada: 0.7731816613604637
```

2.16 Aplicando DecisionTreeClassifier com K-fold

```
In [472]: metodo = 'Tree'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              tree = DecisionTreeClassifier()
              tree.fit(x_train, y_train)

              y_predict = tree.predict(x_test)

              calcula_metricas(metricas, y_test, y_predict)

          for metrica, value in metricas.items():
              metricas[metrica] = value/10

          show_metricas(metricas)
          write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.7755370026798598
Recall: 0.8364393341690827
```

```
Precisão: 0.8448544863634206
F-Measure: 0.840492706647386
Curva Roc: 0.7318464461247458
Indice Kappa: 0.4605835521962433
Acuária Balanceada: 0.7318464461247458
```

2.17 Aplicando SVM com K-fold

```
In [473]: metodo = 'SVM'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              svm = SVC()
              svm.fit(x_train, y_train)

              y_predict = svm.predict(x_test)

              calcula_metricas(metricas, y_test, y_predict)

          for metrica, value in metricas.items():
              metricas[metrica] = value/10

          show_metricas(metricas)
          write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.7951865594722738
Recall: 0.8322422854221699
Precisão: 0.8722890167173055
F-Measure: 0.8516504561170238
Curva Roc: 0.7682771005851456
Indice Kappa: 0.5199464856631275
Acuária Balanceada: 0.7682771005851456
```

2.18 DataFrame Balanceado

```
In [474]: formato = 'Balanceado'

In [475]: data_np_x = balanced_df.drop_duplicates().drop(columns=['Class']).to_numpy()
          data_np_y = balanced_df.drop_duplicates()['Class'].to_numpy()

In [476]: folds_value = 10

In [477]: kf = KFold(n_splits=10, shuffle=True, random_state=random.randint(0, 10))
          data_kfold = kf.split(data_np_x)
```

```
train = []
test = []

for train_index, test_index in data_kfold:
    train.append(train_index)
    test.append(test_index)
```

In [478]:
```
name_file = 'metricas-' + formato + '.csv'

f = open(name_file, "w")
f.write(';Acurácia;Recall;Precisão;F1;Roc;Kappa;Acurácia Balanceada\n')
f.close()
```

2.19 Aplicando KNN com K-fold

In [479]:
```
metodo = 'KNN'
metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

for train_index, test_index in zip(train, test):
    x_train, x_test = data_np_x[train_index], data_np_x[test_index]
    y_train, y_test = data_np_y[train_index], data_np_y[test_index]

    neigh = KNeighborsClassifier(n_neighbors=1)
    neigh.fit(x_train, y_train)

    y_predict = neigh.predict(x_test)

    calcula_metricas(metricas, y_test, y_predict)

for metrica, value in metricas.items():
    metricas[metrica] = value/10

show_metricas(metricas)
write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.8700555045322046
Recall: 0.8684301031357075
Precisão: 0.8720693245828419
F-Measure: 0.8699248356969236
Curva Roc: 0.8701609387223972
Indice Kappa: 0.7395285925502113
Acuária Balanceada: 0.8701609387223972
```

2.20 Aplicando GaussianNB com K-fold

In [480]:
```
metodo = 'Gauss'
metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba
```

```
    for train_index, test_index in zip(train, test):
        x_train, x_test = data_np_x[train_index], data_np_x[test_index]
        y_train, y_test = data_np_y[train_index], data_np_y[test_index]

        gauss = GaussianNB()
        gauss.fit(x_train, y_train)

        y_predict = gauss.predict(x_test)

        calcula_metricas(metricas, y_test, y_predict)

    for metrica, value in metricas.items():
        metricas[metrica] = value/10

    show_metricas(metricas)
    write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.7442069640218825
Recall: 0.6631589812319786
Precisão: 0.7924692452982228
F-Measure: 0.7212104770648144
Curva Roc: 0.7440491041047028
Indice Kappa: 0.4874987636843975
Acuária Balanceada: 0.7440491041047028
```

2.21 Aplicando DecisionTreeClassifier com K-fold

```
In [481]: metodo = 'Tree'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              tree = DecisionTreeClassifier()
              tree.fit(x_train, y_train)

              y_predict = tree.predict(x_test)

              calcula_metricas(metricas, y_test, y_predict)

          for metrica, value in metricas.items():
              metricas[metrica] = value/10

          show_metricas(metricas)
          write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.8365431457892425
Recall: 0.8388445212265723
Precisão: 0.837190578980462
F-Measure: 0.8373937923510791
Curva Roc: 0.8363343132041047
Indice Kappa: 0.6721658819534905
Acuária Balanceada: 0.8363343132041047
```

2.22 Aplicando SVM com K-fold

```
In [482]: metodo = 'SVM'
          metricas = {'acc': 0, 'recall': 0, 'precision': 0, 'f1': 0, 'roc': 0, 'kappa': 0, 'ba

          for train_index, test_index in zip(train, test):
              x_train, x_test = data_np_x[train_index], data_np_x[test_index]
              y_train, y_test = data_np_y[train_index], data_np_y[test_index]

              svm = SVC()
              svm.fit(x_train, y_train)

              y_predict = svm.predict(x_test)

              calcula_metricas(metricas, y_test, y_predict)

          for metrica, value in metricas.items():
              metricas[metrica] = value/10

          show_metricas(metricas)
          write_metricas(name_file, metricas, metodo)
```

```
Acuária: 0.8438046559916945
Recall: 0.7710744526685108
Precisão: 0.9033264871646102
F-Measure: 0.8310090726922817
Curva Roc: 0.8440004071747682
Indice Kappa: 0.6870582735808017
Acuária Balanceada: 0.844000407174768
```